A Space-based Classification System for RF Transients

K. R. Moore, J. F. Wilkerson, Darrell Call, Sandra Johnson, Tanya Payne, Wendell Ford, and Ken Spencer
Los Alamos National Laboratory
Los Alamos, NM, 87545
USA

Chris Baumgart
EG&G/Los Alamos
Los Alamos, NM, 87545
USA

ABSTRACT.

The FORTE (Fast On-Orbit Recording of Transient Events) small satellite is scheduled for launch in mid 1995. The mission is to measure and classify VHF (30-300 MHz) electromagnetic pulses, primarily due to lightning, within a high noise environment dominated by continuous wave carriers such as TV and FM stations. The FORTE Event Classifier will use specialized hardware to implement signal processing and neural network algorithms that will perform onboard classification of RF transients and carriers. Lightning events will also be characterized with optical data telemetered to the ground. A primary mission science goal is to develop a comprehensive understanding of the correlation between the optical flash and the VHF emissions from lightning. By combining FORTE measurements with ground-based measurements and/or active transmitters, other science issues can be addressed. Examples include the correlation of global precipitation rates with lightning flash rates and location, the effects of large-scale structures within the ionosphere (such as traveling ionospheric disturbances and horizontal gradients in the total electron content) on the propagation of broad bandwidth RF signals, and various areas of lightning physics. Event classification is a key feature of the FORTE mission. The robustness and adaptability of neural networks make them promising candidates for this application. We describe the proposed FORTE Event Classifier flight system, which consists of a commercially available digital signal processing board and a custom board, and discuss work on signal processing and neural network algorithms.

1. FORTE MISSION OVERVIEW

FORTE (Fast On-Orbit Recording of Transient Events) is a United States of America Department of Energy small satellite experiment scheduled for launch in mid 1995. The payload will measure VHF (30-300 MHz) electromagnetic pulses within a noise environment dominated by continuous wave carriers such as TV and FM stations. The Pegasus XL spacecraft will provide a circular, 68^{o} inclination, 800 km altitude orbit. A primary feature of this mission is the 10 m pseudo-log-periodic antenna coupled to state-of-the-art analog and analog-to-digital electronics.

Because lightning is expected to be the main source of electromagnetic transients in this frequency range, optical information will also be gathered to help characterize lightning events. The optical system combines a photometer and a CCD camera to provide both high spatial and temporal resolution. Both RF and optical system data will be telemetered to the ground for analysis.